New Zealand Journal of Zoology, 1986, Vol. 13: 141–148
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To Carl Carpenter
with compliments
and best wishes
Aaron Bauer
Tony Russell

Hoplodactylus delcourti n. sp. (Reptilia: Gekkonidae), the largest known gecko

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Abstract *Hoplodactylus delcourti* n. sp., is described from a partial specimen of unknown locality. It is distinguished by its huge size (370 mm snout-vent length), large median patch of preanal pores, and dorsal pattern of longitudinal stripes. It is the largest known species of gecko and represents a 54% increase in the maximum recorded snout-vent length for the family. A New Zealand origin for the specimen is supported both by features of its morphology and by congruence with some early reports of a giant lizard of Maori legend. It is not known if the species is extant.

Keywords Reptilia; Gekkonidae; Diplodactylinae; Carphodactylini; *Hoplodactylus delcourti;* new species; gigantism; extinction; *kawekaweau;* subfossil remains

INTRODUCTION

Correspondence between Garth Underwood, Alain Delcourt of the Musée d'Histoire Naturelle de Marseille, and Anthony P. Russell brought to light the existence of a gigantic, hitherto undescribed gecko. Until now the upper-size limit (snout-vent length) of gekkonid lizards was recorded at 240 mm (*Rhacodactylus leachianus* of New Caledonia — largest specimen Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn 25397). In itself this represents a case of true gigantism in the family Gekkonidae. The majority of species have snout-vent lengths that fall far short of this. Of the 800+ described species, only 3% have a maximum recorded head and body length in excess of 130 mm. The specimen described herein increases the maximum recorded snout-vent length for the family by 54%, and thus represents a previously unexpected upper-size range attainable by gekkonids. A review of gigantism within the Gekkonidae is currently in preparation.

Examination by Aaron M. Bauer revealed that the specimen represented a new species of the genus *Hoplodactylus*, until now, known only from New Zealand. Subsequent inquiry has revealed a possible connection between the specimen and the *kawekaweau* of Maori legend. The huge size of the specimen extends our conception of the morphological extremes attainable by gekkonid lizards. It further suggests questions regarding conservation of native reptiles, and the investigation of rare or recently extinct taxa.

The type specimen is unorthodox as it is mounted, incomplete (vertebral column is not present), and lacks locality or collecting data. While these factors do not conflict with the provisions of the International Code of Zoological Nomenclature (1964), it would normally be preferable to delay description until additional material and/or documentation became available. However, as this species is likely extinct, the greatest hope for obtaining additional information lies in creating an awareness of the existence and significance of this unique specimen. For this reason publication is now appropriate.

Received 16 January 1985; accepted 8 October 1985

GENUS *HOPLODACTYLUS* FITZINGER, 1843

Hoplodactylus delcourti n. sp.
(Fig. 1–4)

Diagnosis. A huge *Hoplodactylus* distinguished from all congeners by its size (Snout-vent length [SVL] 370 mm). Digits broadly dilated, a condition shared by all species except *H. granulatus, H. kahutarae* and *H. rakiurae*. Twenty five to twenty seven lamellae under fourth toe (12–18 in *H. chrysosireticus*, 15–19 in *H. duvaucelii*, 9–15 in *H. maculatus*, 10–16 in *H. pacificus*, 11–15 in *H. stephensi*). Lateral apical plate on digit I only (absent

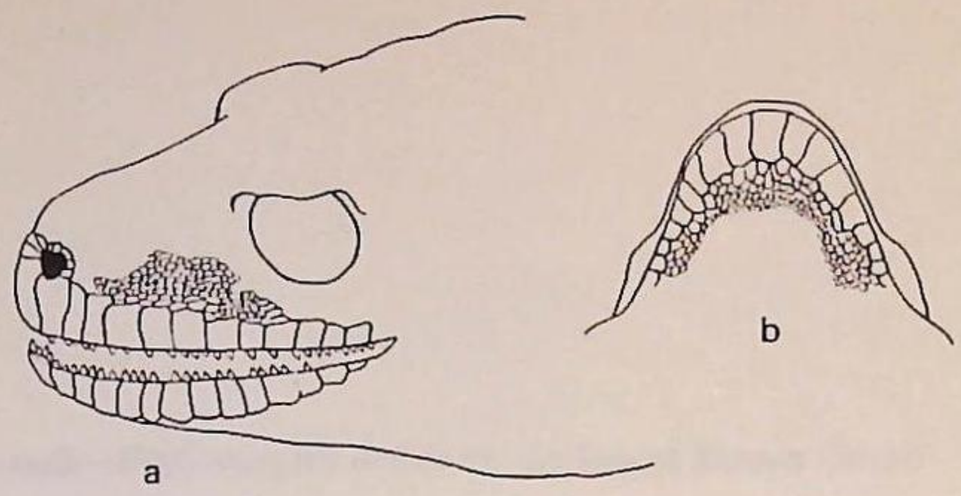


Fig. 1 *Hoplodactylus delcourti* scalation:
(a) head, right lateral view (reversed); **(b)** anterior chin-shields; **(c)** ventral surface of left hindfoot; **(d)** left cloacal spurs; **(e)** preanal and femoral pores (v., vent).

in *H. kahutarae*, present on all digits in *H. rakiurae*). Palmar scales, including those adjacent to base of lamellar series, small, granular; palmar scales larger, ovoid in all congeners. Dorsal colour pattern consists of alternating dark and light longitudinal stripes running from head to tail base. Similar patterns in *H. chrysosireticus*, *H. stephensi* and in some *H. maculatus* and *H. pacificus*. Preanal pores arranged in 8–12 rows in a subtriangular patch (4–6 rows in *H. chrysosireticus*, 5–8 rows in *H. duvauceli*, 3–6 rows in *H. maculatus*, 1–9 rows in *H. pacificus*, 6–9 rows in *H. stephensi*).

Description (see Fig. 1–2). Adult male. Head short, broad; head length 93.8 mm, head width 87.0 mm (across grossly inflated cheeks). Forehead flat. Snout shorter (34 mm) than distance between orbit and ear opening (42 mm). Orbital diameter (distorted by presence of large glass eye) 14 mm. Ear opening oblique. Body robust: SVL 370 mm, axilla-groin length 174 mm. Limbs relatively short and stout — left forelimb: axilla-elbow 45 mm, elbow-base of fourth digit 48 mm, fourth digit 20.5 mm; left hindlimb: groin-knee 51.5 mm, knee-base of fourth digit 68.5 mm, fourth digit 33 mm.

Many scale features, especially digital characters, are difficult to evaluate as the skin has been dried and mounted rather than preserved in spirits.

Digits broadly dilated (except digit I). Lamellae straight, undivided, in uninterrupted series from digit base to penultimate phalanx. Lamellar counts (I–V): left forefoot 14 : 19 : 20 : 22 : 15; right forefoot 12 : 20 : 20 : 23 : 15; left hindfoot 13 : 21 : 25 : 27 : 22; right hindfoot 13 : 21 : 20 : 25 : 21. Digit I with small lateral pad.

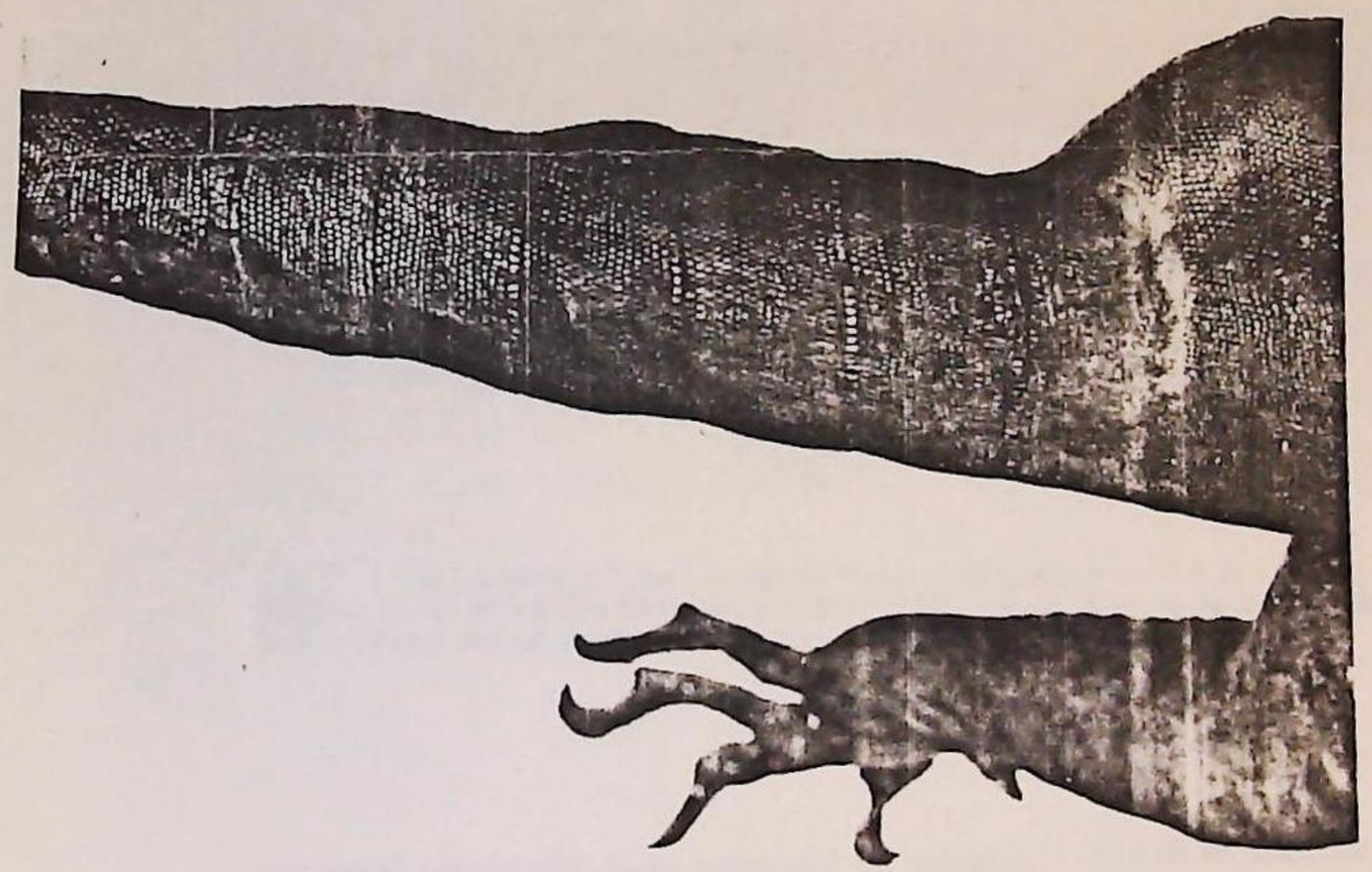


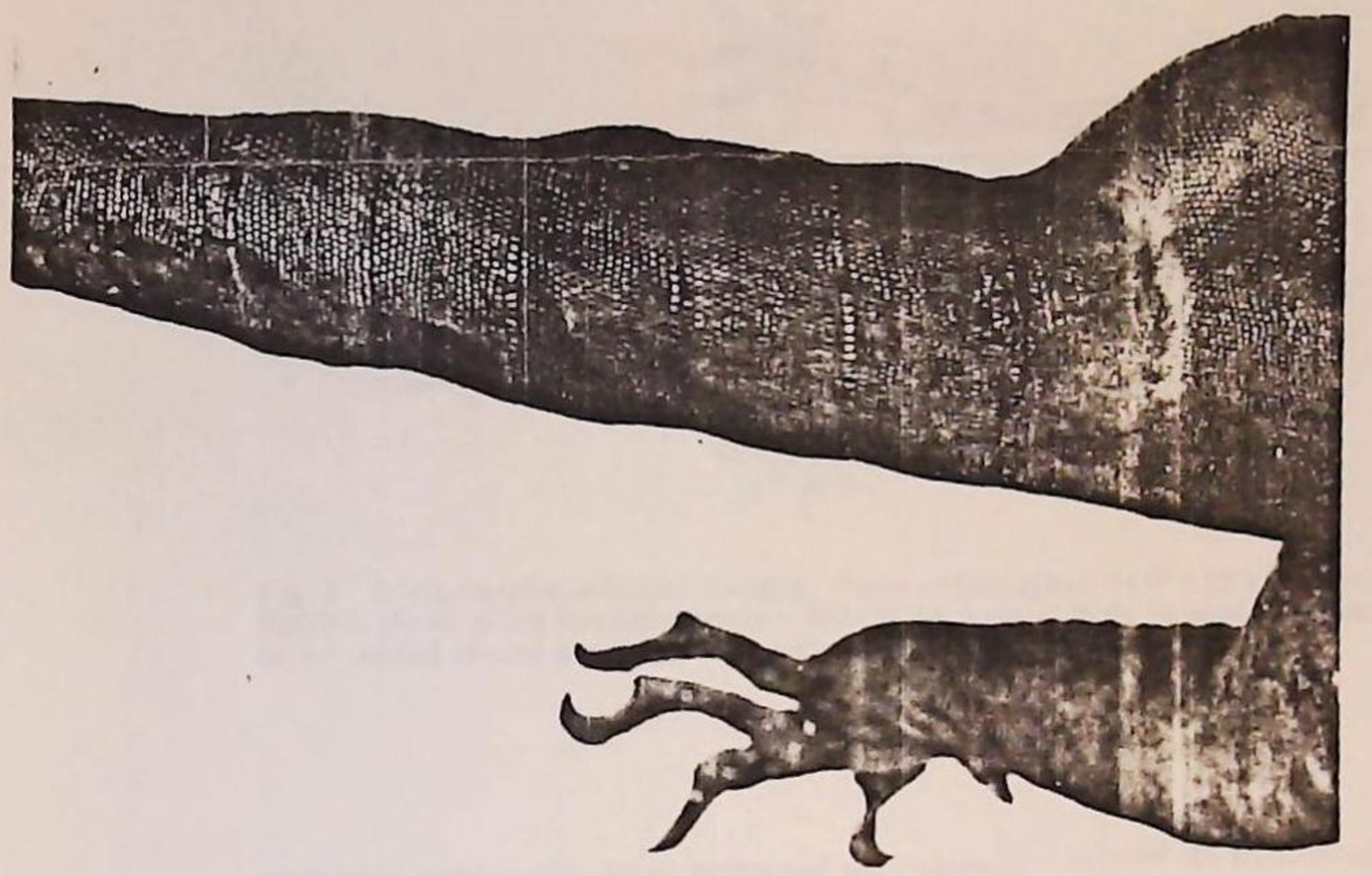
Fig. 2 *Hoplodactylus delcourti*: right hind foot and tail base. Note annuli at each 18th scale row.

Claws long, robust. Interdigital webbing moderate between digits III and IV, weak between I, II, and III, absent between IV and V. Palms broad, bearing many minute granular scales. Dorsal scales on digits large, especially those sheathing claw base.

Dorsal head scales small, granular, 64 interorbitals (31 between supraoccular granules). Rostral 8 mm deep, 13 mm wide, dorsal half of scale divided by median crease. Nostril situated between rostral, first supralabial and eight nasals. Anterior two nasals 3–5 × size of others. Internasal single, large. Twelve (left)—13 (right) supralabials, 12 (right)—14 (left) infralabials. Mental rectangular, 10 mm deep, 7 mm wide. Mental and first infralabials contacted by two to three median chin shields which extend into several series of irregular scales and subsequently decrease to extend into several

(right) enlarged, rounded cloacal spurs. Post-cloacal region covered in larger sub-hexagonal flattened scales. Tail 252 mm, cylindrical, covered with whorls of flat, rectangular scales, with slightly constricted annuli visible every 18th scale row (see Fig. 2), 11 annuli visible in total, tail tip blunt, obscured by taxidermist's seam.

Osteology (see Fig. 3). Details of osteology are given to supplement the somewhat meagre external detail, and to further aid comparison. Only the skull, left medial cloacal-bone, and skeleton of the fore and hind limbs are preserved. Radiographic records reveal the following—skull: quadrate with large conch, broadly expanded laterally, not notched dorsolaterally, lateral-ventral condyle projecting further ventrally than medial one, lateral edge of conch bowed and thickened; posterior process of



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Dorsal scales minute granules, slightly enlarged on anterior faces of limbs. Ventral scales minute, juxtaposed, flat, slightly larger than dorsals, enlarged towards femoral region. A subtriangular patch of enlarged preanal scales, perforated by 8–12 rows of preanal pores, as many as 230 in all (dimpling of surrounding scales makes accurate determination of pore numbers impossible). Four (left) or five (right) enlarged, rounded cloacal spurs. Post-cloacal region covered in larger sub-hexagonal flattened scales. Tail 252 mm, cylindrical, covered with whorls of flat, rectangular scales, with slightly constricted annuli visible every 18th scale row (see Fig. 2), 11 annuli visible in total, tail tip blunt, obscured by taxidermist's seam.

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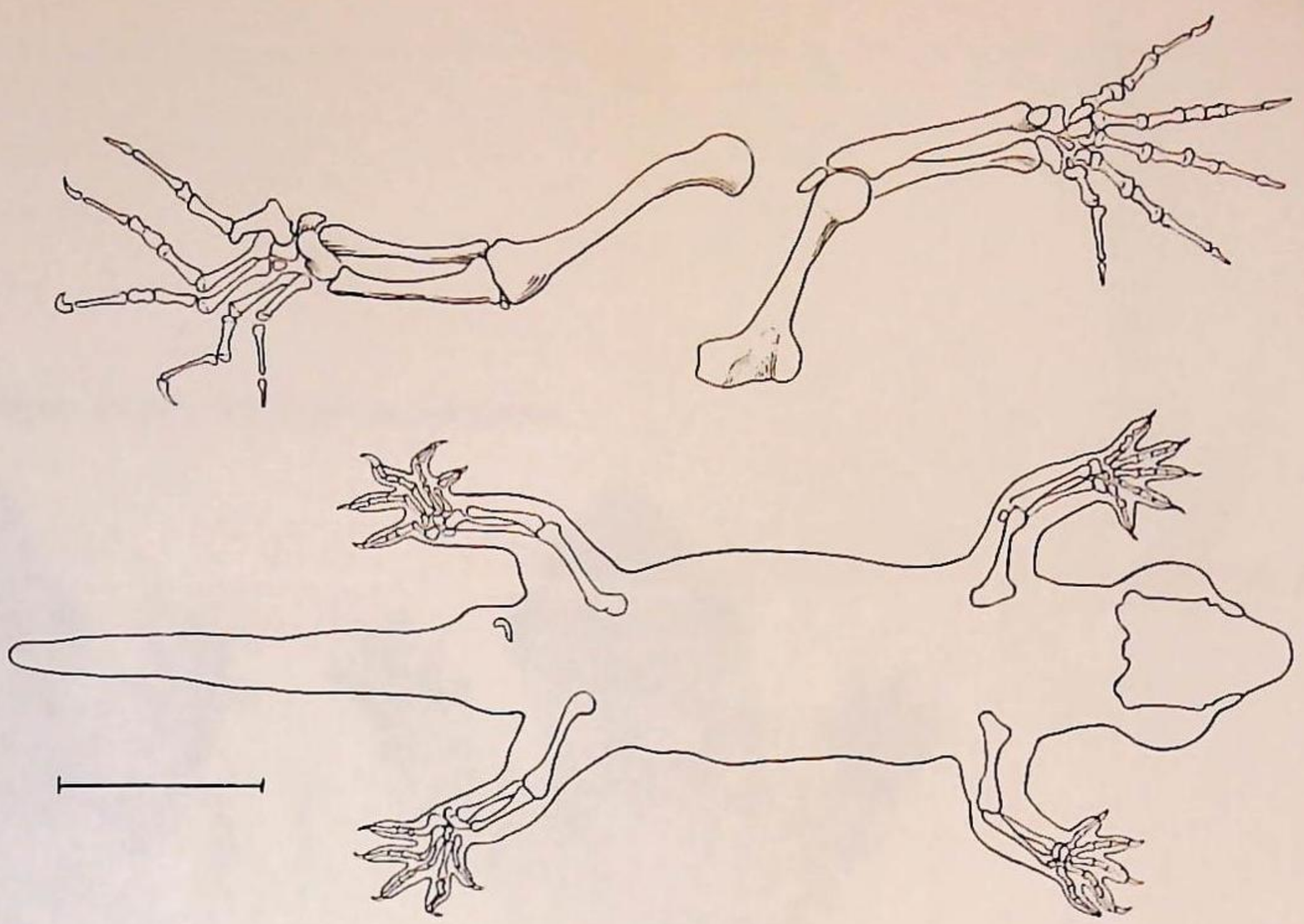

Fig. 3 *Hoplodactylus delcourti* osteology (from radiographs). TOP LEFT, detail of right hindlimb elements; TOP RIGHT, detail of left forelimb elemens; BOTTOM, view of body indicating skeletal elements present (note presence of left medial cloacal bone). Scale = 100 mm.

expanded proximally, large sesamoid on extensor face of elbow; radius distinctly-cupped proximally; ulna slightly longer than radius, with a distinct olecranon process; radiale subtriangular; ulnare square, broad distally; pisiform contacts ulna and ulnare; wedge-like centrale between radiale and ulnare, abuts distal carpals I–IV; distal carpal I smallest and triangular, V second largest, elongate, III squarish, II trapezoid, IV rectangular with long axis following limb long axis; metacarpals radiate from distal carpals; II, III, and IV subequal and longest, I and V subequal and slightly shorter; phalangeal formula 2–3–4–5–3, phalanges associated with subdigital pads depressed and broadened. Hindlimb: femur stout proximally, with large head and trochanter; lunular sesamoid present; tibia stout; fibula slender; astragalocalcaneum with fibular wing; cuboid large, tapered somewhat distally; fifth metatarsal greatly hooked, with well-developed lateral and medial processes, long axis of shaft of metatarsal V lies parallel to that of metatarsal IV; long axis of digit V set off laterally at an angle from long axis of its metatarsal; distal tarsal III present, triangular with apex directed proximally, abuts head of metatarsal III distally, II medially and cuboid laterally, fitting into recess in the medial face of the cuboid; metatarsals I–III comprise a series of increasing length; metatarsal IV subequal in length to II and slightly shorter than III; metatarsals I–IV subparallel, with III and IV very closely bound together; proximal head of metatarsal III overlies that of IV, IV overlies that of V; proximal head of metatarsal IV only very slightly expanded medially, but extensively laterally — not drawn out into a proximally directed apex; phalangeal formula 2–3–4–5–4; phalangeal details are as for the forelimb.

Colour (see Fig. 4). *Hoplodactylus delcourti* bears a pattern of dark reddish-brown longitudinal dorsal stripes very similar to that seen in *Hoplodactylus stephensi*, *H. chrysosireticus*, and certain *H. maculatus* and *H. pacificus*. The background colour of the animal is a yellowish-brown. Two broad dorsal stripes, extending from either side of the parietal region to the level of the cloaca, are separated for

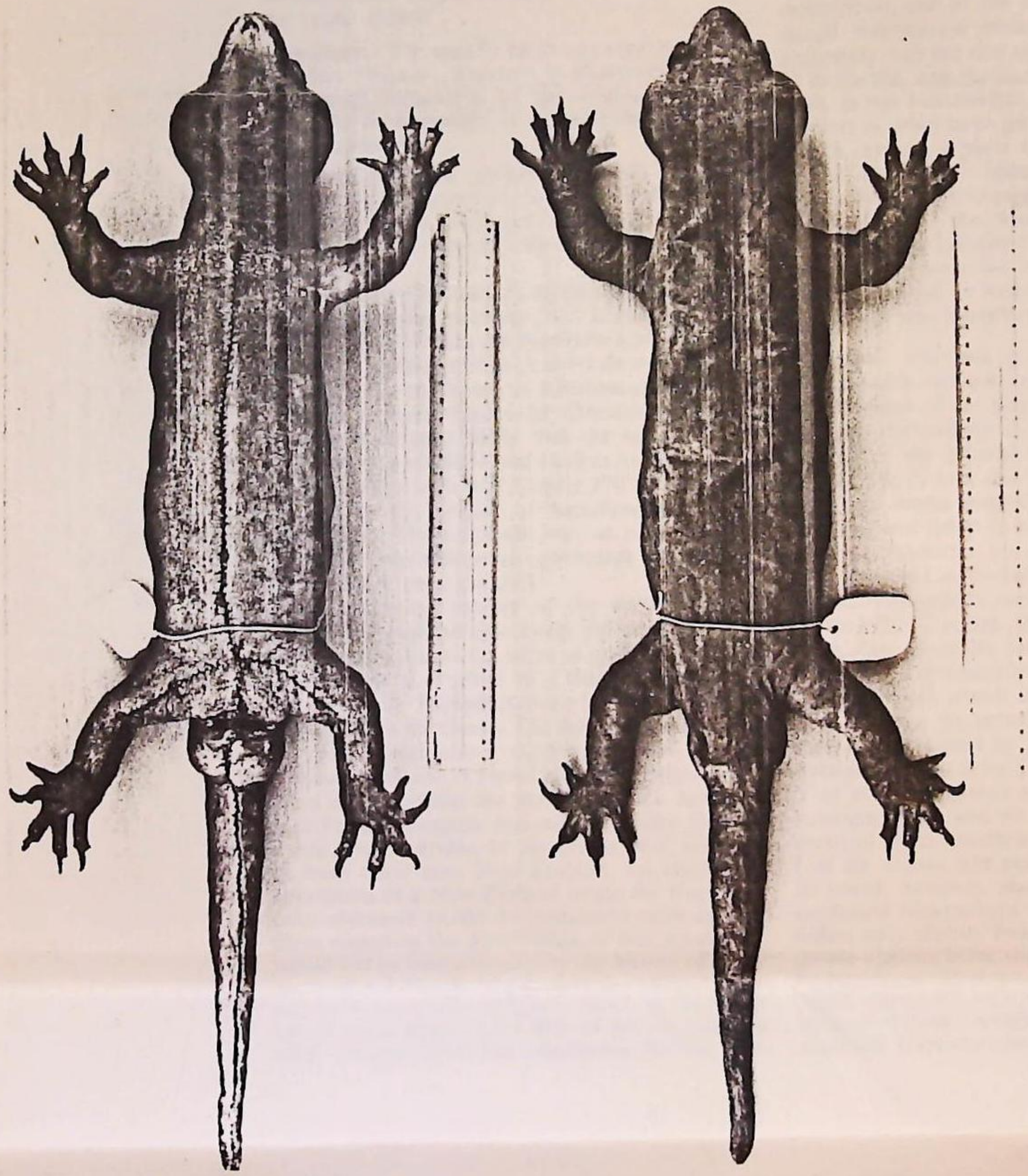

Fig. 4 *Hoplodactylus delcourti* colour and pattern: ventral and dorsal views of the holotype (MMNH 1985-38). Note the patch of preanal pores and the pattern of alternating light and dark longitudinal stripes. Rule equals 300 mm.

most of their length by a narrow mid-dorsal stripe of background colour. Dorsolateral and lateral stripes extend from the axilla to the groin. No patterns are discernable on the tail or limbs. The venter is unmarked and is slightly lighter in colour than the dorsum.

It should be noted that the colour of the specimen may have been altered by the method of preservation. The specimen, in addition to being tanned, appears to be coated in some type of shellac or varnish that has yellowed with time. The colour in life was probably light-brown with the darker, dorsal stripes being a dark brick-red, and the venter cream.

Etymology. The specific epithet recognises the role of Alain Delcourt, assistant in charge of the herpetological collections of the Musée d'Histoire Naturelle de Marseille, in bringing this specimen to our attention.

Type data. Holotype (MMNH 1985-38) — no data accompany the specimen. Based upon the circumstantial evidence presented below we restrict the type locality to 'possibly the North Island, New Zealand'.

The Musée d'Histoire Naturelle de Marseille, the repository of the specimen, was founded in 1819, and it is possible that the specimen represents part of the original collections. A latest date of 1902 can be set on the specimen, as subsequently obtained material is accompanied by chronological information. It is most likely that the specimen was acquired between 1833 and 1869 as no records survive from this period (Vayssière 1901). This could account for the absence of documentation of the giant gecko. The specimen was on public display for many years before its significance was realised (A. Delcourt, pers. comm.).

The collection locality of the specimen is in doubt. Although no data exist, the morphology of the specimen limits the areas of possible origin, as it represents a member of a limited radiation of the subfamily Diplodactylinae (see below) in the southwest Pacific Ocean. The first possibility is that the animal originated in the French island territory of New Caledonia. A New Caledonian origin would more easily explain the presence of the specimen in a French museum but would require that the genus *Hoplodactylus*, in the recent past, occurred in areas other than New Zealand. An alternative hypothesis of a New Zealand origin for *Hoplodactylus delcourti* would be consistent with current ideas regarding the distribution of this genus, and would not be inconsistent with the history of many areas of the North Island. French explorers, scientists and settlers were quite active in the North Island, particularly in the Bay of Islands (Hocken 1908; Wright 1950). The contention that the specimen is from New Zealand is also supported by some historical and anecdotal records from Maori and European sources.

A number of the older descriptions of the lizards of Maori legend are suggestive of the new species. The most valuable information comes from Mair (1873) who commented on "the existence of a large forest lizard, called by the Maoris *kaweau*." He continues, "In 1870 an Urewera chief killed one under the loose bark of a dead rata, in the Waimana Valley, he described it to me as being about two feet long and as thick as a man's wrist; colour brown, striped longitudinally with dull red." This description, one of the only to provide morphological information about giant lizards, matches extremely well the size and colour of the specimen in Marseille, and the position of the lizard, under bark, is not inconsistent with the known daytime retreats of other large geckos. This and other nineteenth century reports of the *kaweau* or *kawekaweau* from North Island localities are discussed by Hardy (1977) who suggests a connection between this reptile and the skink *Leiolopisma gracilicorpus*. The actual identity of the *kawekaweau* remains in doubt, however, we believe that *Hoplodactylus delcourti* should be included in any future considerations of this legendary creature.

Affinities. The lack of locality data dictates that all potential avenues concerning its identity and relationships of the specimen be examined. Morphology, particularly the uniquely derived configuration of the preanal pores in a median patch (Kluge 1967), and the subparallel, tightly bound third and fourth metatarsals (Rusell 1972) suggest that the new taxon is a member of the tribe Carphodactylini within the subfamily Diplodactylinae.

Within the Carphodactylini only members of the genera *Heteropholis (sensu lato)* (see Meads 1982; Robb 1982; Thomas 1982): *Naultinus, Hoplodactylus, Rhacodactylus, Eurydactylodes*, and *Bavayia*, share with *Hoplodactylus delcourti* a strongly clawed first digit with a well demarcated subdigital pad. Five of these six genera share three derived features not possessed by *Heteropholis* (*sensu lato*): a strongly arcuate penultimate phalanx on digits II–V of both the manus and pes; broadly expanded subdigital pads; and the presence of a small, asymmetrical distal lamella adjacent to the claw on digit I of the manus and pes (Russell 1972). It should be noted, however, that Thomas (1982) has synonymised *Heteropholis* with *Naultinus*. The latter differs only slightly from *Heteropholis*, the penultimate phalanx being slightly more arcuate and the asymmetrical distal lamella being present. It thus seems reasonable to treat *Naultinus* and *Heteropholis* as a single assemblage. Thomas (1981, 1982) regarded *Hoplodactylus* as being the most primi-

tive of the New Zealand genera. Superficially this does not accord with the polarity of the above features, but when considered in the light of more extensive osteological evidence it appears that *Naultinus-Heteropholis* is paedomorphic relative to *Hoplodactylus* (Stephenson & Stephenson 1956), and the digital features cited may well be indicative of this condition.

Hoplodactylus appears to be the sister group of the New Caledonian genera and shares with them a more completely elevated penultimate phalanx on digits II–V of the manus and pes. In *Hoplodactylus* the free distal portion of the digit is not as fully incorporated into the confines of the pad as it is in the three New Caledonian genera. In *Rhacodactylus* the distal portion of digits II–V is moderately free, in *Eurydactylodes* it is barely free and in *Bavayia* it has been completely subsumed within the expanded portion of the digit. Additionally *Bavayia* possesses divided subdigital lamellae.

Hoplodactylus also shares with the newly described taxon the unique feature of regularly-spaced annuli on the tail. These annulations are visible on the original portions of the tail as slight constrictions and are surrounded by a single whorl of scales, each only slightly smaller than those of the adjacent scale rows. The annuli correspond to the position of the autotomic septa of the tail. This feature is lacking in other members of the New Zealand/New Caledonian assemblage, although a series of slight constrictions may be discernible along the tail of *Eurydactylodes*.

The addition of *Hoplodactylus delcourti* raises to nine the number of species included within the genus *Hoplodactylus* (see McCann 1955; Robb & Rowlands 1977; Robb 1980; Thomas 1981; Whitaker 1984). Features distinguishing *H. delcourti* from its congeners are presented in the diagnosis.

Current status. Although no living *Hoplodactylus delcourti* are known, we cannot deny the possibility that populations of this species still exist. If the species is indeed the *kawekaweau* of Maori legend, annecdotal sources suggest that the northern North Island may be a region likely to support surviving populations. Two of *H. delcourti's* smaller, but nonetheless spectacular congeners, *H. rakiurae* Thomas 1981 and *H. kahutarae* Whitaker 1984 have only recently been discovered in remote parts of New Zealand. It is possible that a 370 mm SVL gecko with nocturnal habits, isolated and hidden retreats, and low population density, might still go unnoticed.

Several implications may be drawn from the discovery of a specimen of a giant *Hoplodactylus*. The first is to stimulate workers in New Zealand to try to locate additional material pertaining to the species. A potentially more rewarding task would be to critically re-examine the large amounts of subfossil remains available in the collections of New Zealand museums. Remains of many of the living geckos and skinks, including forms larger than those extant (Millener 1981; Newman 1982) have been identified. Much more material exists for *Sphenodon*. Mixed in among the tuatara bones may be material belonging to *H. delcourti*. It is possible that such fragments, except for intact portions of the skull, would almost certainly be mistaken for the remains of the tuatara by all except those with training in reptilian osteology. Although many differences exist between the skeletons of these animals, their similar size and expectation that large reptile bones found in new Zealand are tuatara bones, may have confounded the matter. It is our hope that the description of *Hoplodactylus delcourti* may stimulate herpetologists in New Zealand to re-examine materials currently at their disposal and to seek out new evidence bearing on this giant gecko.

ACKNOWLEDGMENTS

We thank Garth Underwood and Alain Delcourt for bringing the existence of this specimen to our attention. Y. L. Werner (Jerusalem), W. Böhme (Bonn), A. E. Greer (Sydney) and KdQ (Berkeley) discussed the specimen with the senior author and provided useful insight. A. H. Whitaker, B. W. Thomas, D. Towns, B. Gill, G. Hardy, D. G. Newman and J. Robb assisted in locating specimens, photographing specimens for comparative purposes, providing obscure references and following up leads on the specimen. M. H. Wake critically read the manuscript. Illustrations were prepared by G. Christman (Museum of Vertebrate Zoology, University of California, Berkeley). Photographs of the specimen are courtesy of M. Papazian and the Musée d'Histoire Naturelle de Marseille. Radiographs were prepared by Mme Del Rio and Dr Brun-Foucou (centre de Radiodiagnostic de la Ville de Marseille). This work was supported by the Marsh Fund of the National Academy of Sciences (U.S.A.) (1983–185), the California Academy of Sciences (San Francisco), the Museum of Vertebrate Zoology and Department of Zoology, University of California, Berkeley, and the National Sciences and Engineering Research Council of Canada (A9745).

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